

CLAIMS

1. An input apparatus that outputs coordinate values of an operation surface that the user has pressed as an input operation, deforms the operation surface, and causes the user to feel a force sense as a feedback with the deformed operation surface, comprising:

a deformation mechanism portion that uses a piezoelectric actuator composed of a piezoelectric bimorph device and that deforms the operation surface;

a press force detection portion that detects whether the operation surface has been pressed; and

a control portion that controls said deformation mechanism portion to start driving the piezoelectric actuator to gradually deform the operation surface in one direction and then in the reverse direction so that the period for which the operation surface is deformed in one direction is sufficiently larger than the period for which the operation surface is deformed in the reverse direction when said press force detection portion detects that the operation surface has been pressed.

2. The input apparatus as set forth in claim 1, wherein when the maximum deformation amount of the operation surface deformed by said deformation mechanism portion is 200 μm or less, the period for which the operation surface is deformed in one

direction is 33 times or more than the period for which the operation surface is deformed in the reverse direction.

3. The input apparatus as set forth in claim 1,
5 wherein the period for which the operation surface is deformed in the first direction is 200 msec or less.

4. The input apparatus as set forth in claim 1, further comprising:

10 a deformation amount set portion that sets the deformation amount of the panel surface corresponding to setting of the user,

wherein said control portion deforms the operation surface corresponding to setting of the
15 deformation amount of the operation surface.

5. The input apparatus as set forth in claim 4,
wherein said control portion gradually increases or decreases a drive voltage of the piezoelectric actuator always corresponding to the same
20 waveform and varies the period for which the drive voltage increases or decreases corresponding to the waveform to vary the deformation amount of the operation surface in one direction.

6. The input apparatus as set forth in claim 1,
25 wherein said control portion controls said deformation mechanism portion to keep the operation surface deformed in the reverse direction until said

press force detection portion detects that the operation surface has been pressed.

7. The input apparatus as set forth in claim 6,

wherein said control portion controls said deformation mechanism portion to deform the operation surface in the reverse direction for a predetermined period and the operation surface for a period sufficiently longer than the predetermined period so that the voltage applied to the piezoelectric actuator becomes 0 V when said press force detection portion detects that the operation surface has been pressed.

8. The input apparatus as set forth in claim 1,

wherein said deformation mechanism portion has:

a first spacer disposed on a front surface in the vicinity of a center portion of the piezoelectric actuator; and

a second spacer and a third spacer disposed on an opposite surface of the front surface of the piezoelectric actuator, the second spacer and the third spacer being disposed in the vicinity of end portions in the longitudinal direction of the piezoelectric actuator,

wherein the piezoelectric actuator is curved in the direction perpendicular to the surfaces on which the spacers are disposed so as to vary the distance between the front surface of the first spacer and the

front surface of the second and third spacers and deform the operation surface.

9. The input apparatus as set forth in claim 1, further comprising:

5 a display portion that transmits the operation surface and displays a screen,

wherein when an operation function item displayed on said display portion is pressed through the operation surface, the operation function item is selected and input.

10. A portable electronic apparatus comprising: the input apparatus as set forth in claim 1.

11. A remote control apparatus comprising: the input apparatus as set forth in claim 1.

15 12. A piezoelectric actuator drive control method for an input apparatus that outputs coordinate values of an operation surface that the user has pressed as an input operation, deforms the operation surface with a piezoelectric actuator composed of a piezoelectric bi-morph device, and causes the user to feel a force sense as a feedback with the deformed operation surface, comprising the step of:

starting applying a voltage to the piezoelectric actuator and driving the piezoelectric actuator to gradually deform the operation surface in one direction and then in the reverse direction so that the period for which the operation surface is deformed

in one direction is sufficiently larger than the period for which the operation surface is deformed in the reverse direction when it is detected that the operation surface has been pressed.

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